THE JOURNAL OF

THE INSTITUTION OF PRODUCTION ENGINEERS

Vol. 31, No. 2, February 1952

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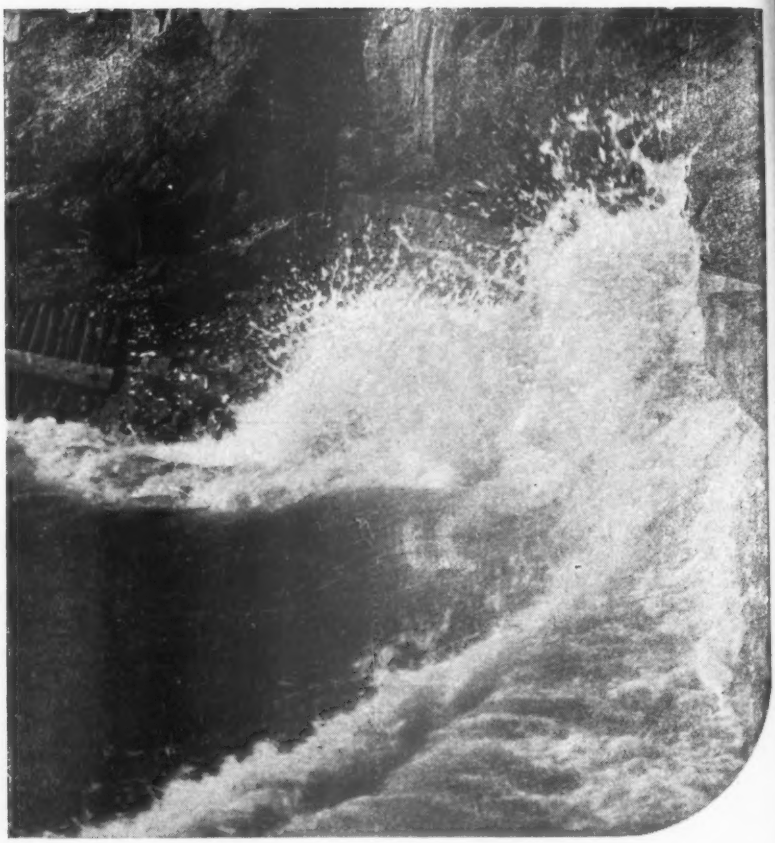


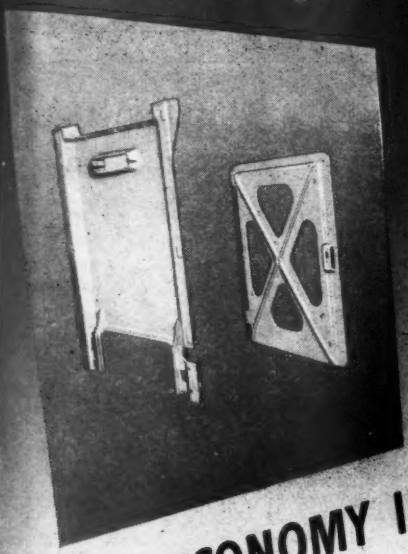
Concerning Impact Strength

The sea defences built along our wild coasts must withstand terrific battering shocks and the impact of stormy seas. MAZAK though not called on for resistance to such dramatic applications must also withstand shock, impact and strain. MAZAK has remarkably high impact strength and can be relied on for die castings where resistance to shock is of major consideration.

MAZAK

IMPERIAL SMELTING

IMPERIAL SMELTING CORPORATION (SALES) LIMITED • 37 DOVER STREET • LONDON W.1



CASTING OPERATION

FOR ECONOMY IN FINISHING COSTS

The illustration shows aluminium die-castings comprising the Back Frame and Door Frame of the "Cannon" Gas Cooker. Our customers say: The main advantages of using aluminium die-castings can be summarised as follows:—

1. Reduction in overall weight of the Cooker which permits of the greater use of women labour in assembly.
2. The elimination of spray painting usually necessary to prevent corrosion.
3. Substitution for vitreous enamelled castings in certain cases where the finish has to withstand severe conditions.
4. Easy machinability, especially in cases where the machining of other materials is an expensive process.
5. Greater dimensional accuracy in casting.

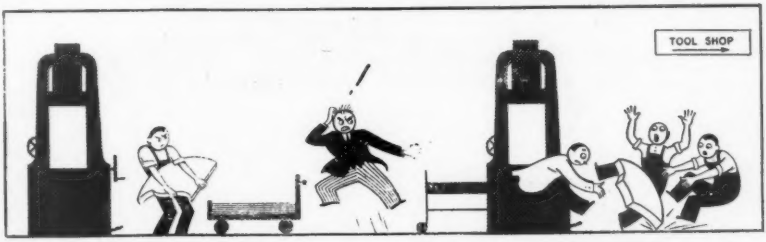
Extract from a letter from Messrs. Cannon Iron Foundries Ltd., Bilston, Staffs.

BIRMAL

BIRMINGHAM ALUMINIUM CASTING (1903) CO LTD

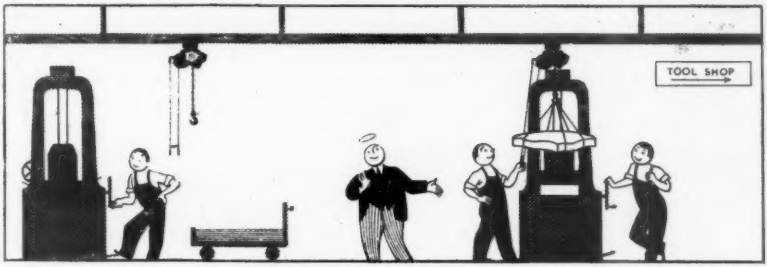
BIRMID WORKS · SMETHWICK · BIRMINGHAM 40

Everything happens in *some* factories



(Above) **IDLE MACHINES,** avoidable fatigue and accidents are part of the real cost of out-of-date handling. It tends to make its mark in the balance sheet when goods are heaved and humped about by hand.

(Below) **WHAT A DIFFERENCE** when lifting and shifting are *organised*, part of a smooth production flow! Nearly always it means more production, less effort, lower cost per unit.



YOU'RE PAYING FOR A MODERN HANDLING SYSTEM whether you have it or not! Replace all the humping and heaving with modern materials handling gear and you save all along the line. A well-planned installation quickly pays for itself and goes on saving time, money and effort year in year out.

Your problem is 'different'? Many of the most successful KING installations have been designed to fit a specialised need, from the sixteen miles of KING conveyors in the new Austin plant to small runway layouts.

You will find in KING booklets many useful ideas about Overhead Conveyors, Floor Conveyors, Travelling Cranes, Electric Pulley Blocks and Runways. Look into this; there's no obligation except ours—to help you speed output and cut costs.

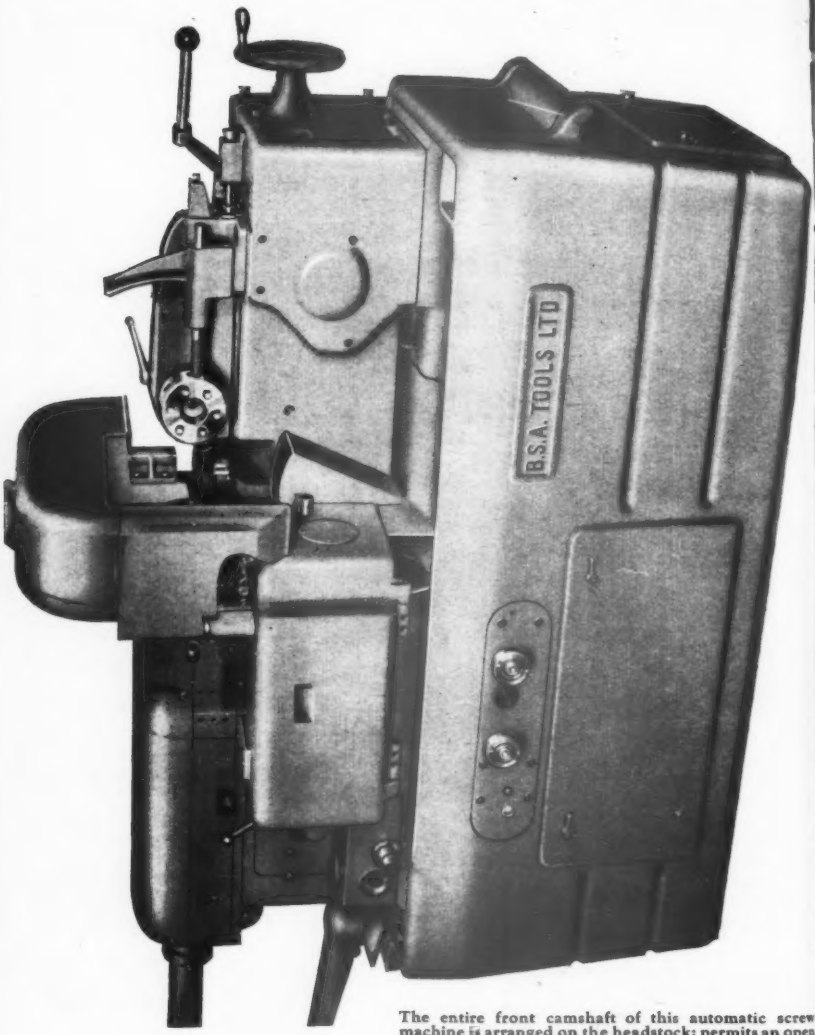
Here is a KING Dual Conveyor on the job in a famous nut and bolt factory. Note the special tip-bins.

Refrigerators travel from Assembly to Dispatch Stores on a KING wooden slat floor conveyor in the Frigidaire factory.

WRITE FOR ILLUSTRATED BOOKLETS

KING

GEO. W. KING LTD.
502, WORKS, HITCHIN, HERTS.
AND AT STEVENAGE.
Telephone: HITCHIN 960



The entire front camshaft of this automatic screw machine is arranged on the headstock; permits an open front of generous proportions, gives maximum swarf-clearance and accessibility. Ease of operation and change-over are among its features. With guards and covers in position no moving part is exposed. Known as the "L" Type, the machine is in three sizes: 1⅛", 1¼" and 2" capacity. Brochure gives full details, is available on request to makers: B.S.A. Tools Ltd., Birmingham, England, or to their agents for U.K.: Burton Griffiths & Co., Ltd., Marston Green, Birmingham.

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Adelaide (South Australia)	J. M. Steer, 116, Waymouth Street, Adelaide, South Australia.
Melbourne (Victoria, Australia)	C. Pullen, The Institution of Production Engineers, Anderson Hodgson & Co., 360, Collins Street, Melbourne, C.1.
Sydney (N.S.Wales)	J. B. Finlay, 124, North Road, Eastwood, Sydney.

CANADA

Canada	T. H. Beard, 329, Lauder Avenue, Toronto, Ontario.

INDIA

Bombay	E. H. Y. Burden, c/o Machine Tools (India) Ltd., Imperial Chambers, Wilson Road, Ballard Estate, P.O. Box No. 522, Bombay, 1.
Calcutta	J. Warren-Boulton, c/o Machine Tools (India) Ltd., Stephen House, Dalhousie Square, Calcutta.

NEW ZEALAND

New Zealand	H. R. Holmes, Pah Road, Papatoetoe, Auckland.

SOUTH AFRICA

South Africa	The Secretaries, Institution of Production Engineers, Barclays Bank Buildings, Corner Commissioner and Harrison Streets, Johannesburg.

UNITED KINGDOM

Birmingham	A. J. Mansell, 204, Alcester Road South, Birmingham, 14.
Cornwall	F. G. Hawke, 3, Bellevue Terrace, East Hill, Tuckingmill, Camborne, Cornwall.
Coventry	R. F. Eaton, 232, Longfellow Road, Coventry.
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Eastern Counties	L. A. Childs, Crane Ltd., Nacton Road, Ipswich.
Edinburgh	A. Atkinson, Priory House, South Queensferry, West Lothian.
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Halifax	Miss N. E. Bottom (Acting), Hopkinsons, Ltd., Huddersfield.
Leicester and District	G. B. Ball, "Hasledean," 344, Fosse Road North, Leicester.
Lincoln	H. Wright, 101, Longdales Road, Lincoln. Hykeham, Lincoln.
Liverpool	L. C. Jarman, 17, Cambridge Road, Prenton, Birkenhead.
London	R. Hutcheson, Machine Shop Magazine, Dorset House, Stamford Street, London, S.E.1.
Luton	R. M. Buckle, 238, Cutenhoe Road, Luton, Beds.
Manchester	R. S. Clark, 13, Fownhope Road, Ashton-on-Mersey, Sale, Cheshire.
North Eastern	C. C. Hodson, Alfred Herbert Ltd., Carliol Square, Newcastle-upon-Tyne.
Northern Ireland	W. G. Wyman, "Linden Lea," Cultra, Co. Down.
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Nottingham	C. N. T. Manfull, Chellaston House, Thurgarton Street, Nottingham.
Preston	Capt. H. Corthorn, H.Q., North West District, Fulwood Barracks, Preston.
Reading	J. D. Smith, Schools of Technology and Commerce, Cowley Road, Oxford.

Rochester and District Sub-Section	W. G. Clements, 101, Featherby Road, Gillingham, Kent.
Sheffield	E. Levesley, The English Steel Corporation, Ltd., Sheffield.
Shrewsbury Sub-Section	B. G. Williams, "Bryn Heulog," 38, Roselyn, Harlescott, Shrewsbury.
Southern	J. W. Taylor, 44, Deacon Road, Bitterne, Southampton.
S. Essex Sub-Section	P. H. W. Everitt, 6, Hillcrest Road, Loughton, Essex.
South Wales and Mon.	W. D. Porter, 49, Kyle Avenue, Rhiwbina, Cardiff.
Stoke-on-Trent Sub-Section	R. Rowley, North Staffordshire Technical College, Stoke-on-Trent.
Western	A. Eustace, 19, Ferndale Road, Northville, Bristol, 7.
West Wales Sub-Section	H. P. Sanderson, I.C.I. Ltd. (Metals Division), Waunarlwydd, Nr. Swansea.
Wolverhampton	W. J. Marshall, Central View, Norton-in-Hales, Shropshire.
Yorkshire	J. L. Townend, 26, Moor Allerton Drive, Street Lane, Leeds, 7.

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J. Merkine, 45, Arlozoroff Street, Ramat-Gan, Israel.

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THE JOURNAL OF

THE INSTITUTION OF PRODUCTION ENGINEERS

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Contents

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INSTITUTION NOTES

February, 1952

ASSOCIATE MEMBERSHIP EXAMINATION, 1952

THE Associate Membership Examination of the Institution of Production Engineers will be held from Monday, 26th May, to Saturday, 31st May, 1952, inclusive.

All applicants must complete the appropriate form of Application for Membership and return it to Head Office not later than 1st March, 1952. These forms will be assessed by the Council before applicants are accepted as candidates for the examination. No examination entry form is required.

Application forms, copies of the Examination Regulations and copies of the 1951 Examination Papers (price 2s.), may be obtained from the Head Office of the Institution.

NEW YEAR HONOURS

The Institution is pleased to record that the following members were honoured by H.M. The King in the New Year List :—

C.B.E. Mr. R. F. Newman, O.B.E., Member, Director and General Manager, Transport Equipment (Thornycroft) Ltd., Basingstoke.

M.B.E. Mr. F. J. Chard, Member, Production Manager (Brabazon Project), Bristol Aeroplane Co. Ltd., Bristol.

Mr. W. C. Holden, Member, Manager, Variable Speed Gear Production Department, Vickers-Armstrongs, Ltd., Newcastle-upon-Tyne.

Mr. H. O. Norwood, Associate Member, Workshop Manager, Atomic Energy Research Establishment, Harwell.

Mr. J. Skinner, Affiliate Representative, Works and Production Director, Howard & Bullough, Ltd., Accrington.

Mr. G. Swain, Member, Works Manager, James Neill & Co. (Sheffield) Ltd., Sheffield.

FILM STRIP ON PRODUCTION ENGINEERING

A third Strip illustrating the essential characteristics and stages in the Production of Castings by Investment Moulding, or The Lost Wax Process, is now available from the distributors, whose address may be obtained from Head Office.

The strip has been designed to enable students and apprentices to appreciate the application and limitations of this important process. Comment is made on the historical development, and teaching notes are provided to enable a full engineering treatment of the subject to be made. Chemical and metallurgical aspects are not treated quantitatively.

A copy of this Strip may be inspected in the Hazleton Memorial Library at the Institution Head Office.

NEWS OF MEMBERS

Mr. V. N. Agarwala, Associate Member, has been appointed Assistant Superintendent Development (Designs) at the Technical Development Establishment (Ammunition), Poona.

Mr. A. H. Aston, Associate Member, has taken up an appointment as Works Manager with Genatosan, Ltd., Loughborough.

Mr. J. H. Forrington, Associate Member, has recently taken up the appointment of Works Manager with Towson & Mercer, Ltd., Croydon.

Mr. P. E. Goodwin, Associate Member, has been appointed Executive Engineer in charge of all administrative and engineering operations at Vectron, Inc., Waltham 54, Massachusetts.

Mr. J. A. Grainger, Associate Member, has been appointed to the permanent staff at AC Sphinx Spark Plug Co., Southampton, as Master Mechanic, No. 2 Plant.

Mr. R. K. Grunau, Associate Member, now holds the position of Chief Inspector at the Oil Engine Division of Rolls-Royce Ltd., Derby.

Mr. H. R. Haag, Member, has joined Frank F. Pershke, Ltd., London, as General Works Manager.

Mr. W. H. Hooper, M.A. (Cantab), Associate Member, has been appointed Administrative Assistant to the Managing Director of Pest Control, Ltd., Bourn, Cambridge.

Mr. A. Johnston, Associate Member, has taken up a new appointment as Chief Inspector for the Scottish Machine Tool Corporation, Glasgow.

Mr. Akhtar Ahmad Khan, Associate Member, who is Superintendent, Punjab Agricultural Workshop, Lyallpur, Pakistan, has been selected by the Ministry of Food & Agriculture, Government of Pakistan, for a year's advanced training in Agricultural Engineering in the U.S.A.

Mr. J. R. Leighton, Associate Member, has been appointed Works General Manager of Prince-Smith & Stells, Ltd., Keighley.

Mr. C. D. Macmillan, B.Sc., B.Sc. (Eng.), Associate Member, has taken up the appointment of Head of the Department of Mechanical, Production & Civil Engineering at the College of Technology, Rotherham.

Mr. S. P. Mookerjee, Associate Member, is now engaged as Planning Officer (Wagon), with Burn & Co., Ltd., Howrah.

Mr. J. C. Routledge, Associate Member, of Gimson & Co. (Leicester), Ltd., has been appointed a director of that firm.

Mr. C. F. Toe, Associate Member, has been promoted to Chief Engineer and Production Manager of Brillo Manufacturing Co., of Great Britain, Ltd.

Mr. M. E. Clark, Graduate, has taken up an appointment as Engineer III (Design & Development) with the Ministry of Supply.

Mr. W. H. Evans, Graduate, is now employed as a Senior Mechanical Draughtsman with Petrocarbon, Ltd., Manchester.

Mr. W. Hancock, Graduate, has taken up a position as Designer with Appleby-Frodingham Steel Co., Scunthorpe.

Mr. W. A. Hendrie, Graduate, is now employed as a Process Engineer with Hawker Aircraft, Ltd.

Mr. P. T. O'Leary, Graduate, is now a Line Engineer with Metal Containers, Ltd., Ellesmere Port, Cheshire.

Mr. W. L. Seaman, Graduate, has been appointed Systems Division Consultant to the Sheffield Branch of Block & Anderson, Ltd.

Mr. H. V. S. Smith, Graduate, has been appointed Engineer III at the Royal Small Arms Factory, Enfield.

LEICESTER SECTION DINNER

Chief guests chat before the annual dinner of the Leicester Section of the Institution of Production Engineers at the Grand Hotel on Friday, November 23rd. Left to right are: Mr. N. A. Cullin (Section President), Dr. D. F. Galloway (Director of Research, Production Engineering Research Association of Great Britain), who was chief speaker, Mr. H. Burke (Vice-Chairman and Past President of the Institution Council) and Dr. H. Schofield (former Principal of Loughborough College).

HAZLETON MEMORIAL LIBRARY

It would be helpful if, in addition to the title, the author's name and the classification number could be quoted when borrowing books.

ABSTRACTS

658.58 PLANT MAINTENANCE

"The Works Engineer: a practical manual on building and plant maintenance for the Works Manager and Works Engineer" by W. R. J. Griffiths and W. O. Skeat. 3rd Ed. *Pitman, London.* 1951. *384 pages. Illustrated. Diagrams.* 25/–.

This is the third edition of a book which has already found its way into the bookshelf of most Works or Plant Engineers, as a standard work on the elements of works engineering. Many useful suggestions are made on routines, records and general administration of the Works Engineer's Office and a wide range of plant and equipment is described and discussed in some detail.

The book is essentially based on the accumulated experiences of a Works Engineer and as such should be useful to young apprentices and graduates entering the profession. It is written in a manner which can be easily followed and can therefore be recommended also to those who wish to gain general knowledge of the problems of a Works Engineer.

651. OFFICE ORGANIZATION AND METHOD

"Filing and Indexing" by O. W. Standingford. *Office Management Association, London.* 1951. *36 pages. Illustrated.* 5/–.

The report is based on a paper given at a One-Day Conference and Exhibition of Equipment on this subject, held earlier this year. In the course of his paper the author sets out the major steps to be taken in designing a system of filing or overhauling an existing system under such headings as: analysing the requirements, determining classification, selecting the location of the filing section, establishing procedure, and selecting equipment and staff. There is also an illustrated supplement of the machines and devices exhibited.

535.8 OPTICAL INSTRUMENTS

"Introduction to Photo-Elastic Analysis" by Arnold W. Hendry. *Blackie, London.* 1948. *152 pages. Illustrated. Diagrams.* (Blackie's Technique series.)

This monograph is intended to be used as an introductory book for the non-specialist and student, who may eventually use more advanced works. Sufficient elastic theory and optical theory is described to make the subject understandable and there are several suggestions for apparatus and several descriptions of compensators. Chapters are devoted to the reduction of data from photo-elastic tests and materials for models and their preparation. A few pages are devoted to the frozen stress technique. A complete bibliography is included. The text is illustrated with about 70 line drawings and eight plates.

OTHER ADDITIONS

621.9 MACHINE TOOLS; MACHINING

Baker, Warren, and Kozacka, Joseph S. **"Carbide cutting tools, how to make and use them."** *Chic. Am. Tech. Soc.; Lond., Tech. Press.* 1949. *416 pages. Illustrated. Diagrams.*

Boston, Orlan William. **"Metal processing."** (2nd Ed.) *N.Y., Wiley; Lond., Chapman & Hall.* 1951. *763 pages. Illustrated. Diagrams.*

Brown & Sharpe Manufacturing Co., Providence, R.I. **"The Brown & Sharpe Handbook : a guide for young machinists."** *Providence, The Firm.* 1948. *317 pages. Illustrated. Diagrams.*

Kiekebusch, H. **"Die Werkzeugmaschine unter Last : Formanderungen und Beanspruchungen der Drehbank unter Betriebslast."** *Berlin, V.D.I.Verlag.* 1933. *32 pages. Diagrams.*

Woodcock, Frederick L. **"Design of metal cutting tools."** *N.Y., McGraw-Hill.* 1948. *406 pages. Illustrated. Diagrams.*

Brown & Sharpe Manufacturing Co., Providence, R.I. **"Construction and use of the No. 10 cutter and tool grinding machine : a handbook on operation and maintenance."** *Providence, The Firm.* (194–). *70 pages. Illustrated. Diagrams.*

Brown & Sharpe Manufacturing Co., Providence, R.I. **"Construction and use of the No. 13 universal and tool grinding machine : a handbook for the operator."** *Providence, The Firm.* 1947. *110 pages. Illustrated. Diagrams.*

655.3 PRINTING

Montague, Noel. **"Printing management."** *Lond., Sylvan Press.* 1948. *188 pages.*

658 INDUSTRIAL ORGANIZATION ; MANAGEMENT

International Congress of Scientific Management No. 9, Brussels, 1951. **"Rapports presentes aux sections."** *Brussels, C.N.B.O.S.* 1951. *Pages I-1—XII-28.* (Text in English and French.)

658.5 PRODUCTION PLANNING AND CONTROL

Saunders, N. F. T. **"Factory organization and management."** *Lond., Pitman.* 1945. *163 pages.*

Wrba, Max. **"Industrielle Betriebswirtschaft und praktische Betriebsfuhrung."** *Munich, Hanser.* 1949. *198 pages. Diagrams.*

658.7 BUYING ; STORING

U.S.A.—War Department. **"Storage in the zone of the interior."** *Washington, Gov. Pr. Office.* 1946. *131 pages. Illustrated. Diagrams.* (War Dept. technical manual T.M.38–402.)

660 INDUSTRIAL CHEMISTRY

Pierce, David E. **"Chemical engineering for production supervision."** (2nd Ed.) *N.Y., McGraw-Hill.* 1950. *290 pages. Illustrated. Diagrams.* (Chemical engineering series.)

669 METALLURGY

American Society of Metals, Cleveland, Ohio. **"Metals Handbook, 1948 Ed."** Prepared under the direction of the Metals Handbook Committee ; Ed. by T. Lyman. *Cleveland, A.S.M.* 1948. *1,444 pages.*

669.1 IRON AND STEEL

Vanadium Corporation of America, New York. **"Vanadium steels and irons : data sheets."** *N.Y., The Corp.* 1950. *81 pages.*

Mond Nickel Company Ltd., London. **"Isothermal transformation diagrams for nickel steels."** *Lond., The Company.* 1951. *57 pages. Illustrated. Diagrams.*

669.24 NICKEL ; NICKEL ALLOYS

Wiggin, Henry, & Co. Ltd., Birmingham. **"The Nimonic alloys."** *Birmingham, The Company.* 1951. *40 pages.*

Wiggin, Henry & Co. Ltd., Birmingham. **"Wiggin high nickel alloys : methods of joining."** *Birmingham, The Company.* (195–). *42 pages. Diagrams.*

Wiggin, Henry & Co. Ltd., Birmingham. **"Monel, nickel and inconel : hot working, annealing and pickling."** *Birmingham, The Company.* (195–). *52 pages. Illustrated. Diagrams.*

669.6 **TIN**

Greenfield, L. T., and Forrester, P. G. **"The Properties of Tin Alloys."** *Greenford, Tin Research Institute.* 1950. *44 pages.*

Hoare, W. E. **"Tinplate Handbook."** *Greenford, Tin Research Institute.* 1950. *31 pages. Illustrated.*

744 **TECHNICAL DRAWING**

Weir, John J. **"Blueprint reading for the machine trades."** *N.Y., McGraw-Hill.* 1941. *82 pages. Illustrated. Diagrams.*

621.86 **MATERIALS HANDLING**

Materials Handling Conference, No. 3, Philadelphia, Pa., Jan. 1949. **"Materials handling, techniques, case studies, equipment: proceedings of the 3rd annual conference."** *N.Y., A.S.M.E.* 1949. *82 pages.*

658 **INDUSTRIAL ORGANIZATION AND MANAGEMENT**

Sainsbury, Alan J. **"Management of multiple shops."** *Lond., B.I.M.* 1949. *35 pages. Charts.* (Winter proceedings 1948/49, No. 6.)

658.5 **PRODUCTION PLANNING AND CONTROL**

British Institute of Management, London. **"Organizing for output for workers and their representatives,"** *Lond., The Institute.* 1950. *66 pages. Illustrated. Diagrams.*

PAPERS RECEIVED

1844 **"Some Production Problems Involved in Building the Brabazon"** by F. J. Chard.

1846 **"Human Relations in Industry"** by W. P. Kirkwood.

1813 **"Work Assignment and Incentive Payment in Semi-Automatic Machines"** by T. F. O'Connor.

1825 **"Fatigue in Metals"** by Professor J. A. Pope.

BRITISH STANDARDS The following Standard has recently been issued, and may be obtained post free, price 6s., from the British Standards Institution, 24-28 Victoria Street, Westminster, London, S.W.1 :—

761 : 1951 Vertical Multitubular Boilers of Riveted Construction.

THE LIBRARY Members are asked to note that until further notice the Library will not be open on Wednesday evenings or Saturday mornings, but will be open between 10 a.m. and 5.30 p.m. from Monday to Friday each week.

JOURNAL BINDERS Members are reminded that binding cases for the Journal are obtainable from Head Office, price 7/6 each post free. The cases, each of which will hold 12 issues of the Journal, are made of stiff board covered with imitation leather cloth, with gilt lettering on the spine.

RESEARCH PUBLICATIONS A number of copies of the following Research publications are still available to members, at the prices stated :

Report on Surface Finish, by Dr. G. Schlesinger	15/6
Machine Tool Research & Development	10/6
Practical Drilling Tests	21/-
Test Charts for Machine Tools, Parts 3 and 4	5/6 each

These publications may be obtained from the Production Engineering Research Association, "Staveley Lodge", Melton Mowbray, Leics.

ISSUE OF JOURNAL Owing to the fact that output has to be adjusted to meet requirements, and in order to avoid carrying heavy stocks, it has been decided that the Journal will only be issued to new Members from the date they join the Institution.

IMPORTANT In order that the Journal may be despatched on time, it is essential that copy should reach the Head Office of the Institution not later than 40 days prior to the date of issue, which is the first of each month.

GRADUATE ACTIVITIES

BIRMINGHAM GRADUATE SECTION

The Technical Papers Sub-Committee, whose function is to plan future lecture programmes, is now dealing with the syllabus for 1952-53. In order to encourage members who have not previously given papers, the Committee is willing to give advice on technique and presentation. This is also helpful to the Committee, inasmuch as they obtain foreknowledge of papers to be presented.

The Graduate Section Lecture Secretary has been invited by the Senior Section Committee to serve as a representative on their Programme Sub-Committee to ensure a co-ordinated Section policy.

1952 GRADUATE REPRESENTATIVES' CONFERENCE

As the hosts for this year's conference, the Birmingham Graduate Section extend a hearty welcome to all delegates who intend to visit them in March. They will be very happy to have with them any visiting Graduates from overseas, who are cordially invited to participate.

The final Agenda is nearing completion, and it is hoped that any points Sections wish to have discussed will be forwarded to the Birmingham Graduate Chairman as soon as possible.

Most Sections have held special committee meetings on this subject, in order to prepare their delegates for this important conference. Special efforts have also been made to obtain opinions from the main body of the junior members, and in certain cases, general meetings have been found necessary.

Graduates are reminded that they should inform their Section Committees of any items they wish to have considered. The Birmingham Graduate Chairman will be glad to answer any further enquiries regarding the Conference.

COMMON SUBJECT 1951/52

The Common Subject of the present Session is " Development in the Economic Use of Materials," and the London Graduate Section have planned their current programme to suit this theme.

A cycle of three lectures dealing with " Thread Rolling and Cold Forging," " Die Casting " and " Plastic Moulding," respectively, and a Graduate lecture on " Ceramics," to be written by a Graduate specially for the occasion, and several works visits, are all part of this Common Subject programme, which has so far proved to be very popular and most successful.

WORK MEASUREMENT STUDY GROUP

A report on M.T.M. (Methods Time Measurement) has been prepared by the Work Measurement Study Group of the Wolverhampton Graduate Section.

The aim of the group, meeting on eight occasions under the guidance of Mr. N. A. Dudley, B.Sc. (Econ.), M.I.Prod.E., was to investigate the method of work measurement without a stop-watch or any other instrument, which was developed in America by Professor Maynard and colleagues. Members of the group were able to utilise the chronocyclograph and the kymograph of the Wolverhampton and Staffordshire Technical College, which had been specially adapted for the work of the study group.

The report describes the nature of the experiments undertaken, the procedure adopted, the results obtained and the conclusions drawn. It also makes a number of recommendations and expresses the desire to co-operate with other study groups on similar investigations.

The summary of the report and experimental data can be borrowed from the Hazleton Memorial Library.

MECHANICAL HANDLING IN INDUSTRY AND ITS EFFECTS ON COSTS

by W. J. T. DIMMOCK, A.M.I.Prod.E.*

Presented to the London Section of the Institution, 29th March, 1951

MANY of you will know already that nearly all the Productivity Teams who have visited the U.S.A. have commented on the marked and widespread influence of efficient materials handling. A common theme running through their Reports has been that greater output is obtained by freeing the operators to concentrate on maximum utilisation of their productive equipment.

It was for this reason that our Institution co-operated with the Anglo-American Council in sending a specialist team to review this particular aspect of the American economy. The published Report is of deep interest to every member of this Institution. I hope you have read it. If not, perhaps I can persuade you to do so. It is interesting to note that in this survey, several British factories were examined and the group concluded that these were as efficient as any seen in the U.S.A.

It is not my intention to discuss the conclusions or recommendations made in the Report. These you will have to study for yourselves. To-night, I have to indicate the relative importance of mechanical handling and its influence on manufacturing costs.

SCOPE OF MECHANICAL HANDLING

The field of mechanical handling is vast and it is necessary for me to limit the range of my survey. In the main, most of my remarks will be concerned with the cost of handling at factories engaged in light and medium-heavy engineering. On the other hand, the principles and examples quoted will in many instances be applicable to other industries.

A common problem in every factory in all industry is the moving and handling of materials. It is important to grasp the full implication of the handling function. In many factories, 50 tons of materials are lifted, moved, loaded, unloaded, etc., for every one ton of finished product produced. The number of operations of handling to and from each machine or process and the transportation to and from each department greatly exceed the number of direct manufacturing or process operations. Many of these handling operations are unplanned and are rarely shown as a separate cost.

* *Works Manager, Hoover Ltd., Perivale.*

In the total cost of production the cost of handling is a major item. What proportion it bears to the whole varies from one industry to another and, indeed, from one factory to another. It may be as low as 15 per cent. or as high as 85 per cent.

In every factory, large or small, the handling and moving of materials is an important part of the productive process. It is not infrequently the least considered.

To illustrate this point I want you to refer to Data Sheet A. This concerns a small aluminium casting. You will notice in the list of operations that there are 54 events and that only eight of these are direct production operations. But there are 20 transportations, several inspection and quantity checks, 13 periods when the work is standing waiting process and two occasions when it is in an organised store.

It would be unwise to think that this is an exaggerated example. This component was chosen at random and I have reason to believe that sample checks taken in practically any engineering workshop would disclose a similar state of affairs.

It is significant that of the 54 events, only eight have been preplanned and legislated for by the Production Engineer. Likewise, the cost system provides detailed costs for only these eight operations. Hence, of 54 events, 46 are unplanned and for all these there are insufficient detailed costs.

ATTENTION TO INDIRECT COSTS

Only on rare occasions are we fully aware of the multiplicity and true cost of handling operations. We concentrate on events shown in detailed cost statements, and give relatively little attention to the large number of events which are classified under the headings of "On Cost" or "Burden." Perhaps this is one of the reasons why, in many businesses, On Cost or Burden appears to be continuously increasing. Much of the cost of handling and internal transport is frequently lost sight of in cost statements as "indirect labour" and as "general plant and equipment" expenses.

Attempts at reducing indirect costs are usually made in an arbitrary way, sometimes a painful way. I am sure that a lot of this is because of the inadequacy of cost systems in providing the Production Engineer with the true measuring stick to help him appreciate the need for planned method and cost economy in handling and movement.

The planning of production is usually looked on as being largely a job of machine design and process technology, and as a rule, the main interests of the engineer lie in this direction. He has no strong natural inclination to delve into a routine analysis of a mass of accumulated handling and moving operations.

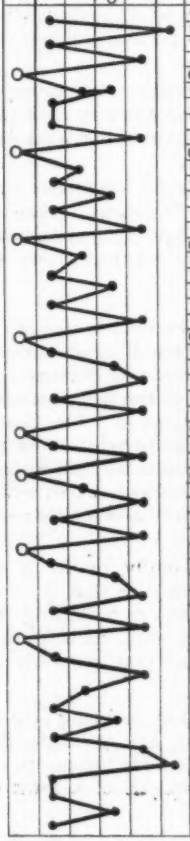
THE INSTITUTION OF PRODUCTION ENGINEERS

CHART SHOWING THE WORK INVOICED IN THE PROGRESS OF A SMALL CASTING

(Size approx. 5 in. dia. by 1½ in.)

Of the 55 events which occur, only 8 (shown in bold type) had been pre-planned. These are the only operations which would be directly shown in a normal costing system.
The cost of quality and quantity checks, transportation, storage and work in process volume are factors which are lumped together in " on cost " statements.

SUMMARY	
Direct Work Operations	8
Transportations	20
Inspections	5
Quantity Checks	7
Delays	13
Storages	2
Distance travelled	2,030 ft
No. of Events	55



Description of Event	Dist. Moved in : Feet	Remarks
Unload Ingots	20	Needs considerable improvement.
Store		
Transport to Diecasting Machine	100	
Await Melting		
O Diecast		
Inspect and Count		
Place in Box Truck		
Transport to Press Shop	200	
Await Trimming		Some of these items can be eliminated by combining quality and quantity check with trimming.
O Trim		
Inspect		
Transport to Checking Bay	90	
Quantity Check		
Transport to Fettling	45	
Await Fettling		
O Fettle		
Inspect		
Transport to Clearance Bay	45	
Quantity Check		
Transport to Capstan	140	
Await Capstan		
O Form, Bore and Ream		
Transport to Checking	110	
Quantity Check		
Await Transport		
Transport to Degreaser	170	Investigate possibility of deletion.
Await Degreasing		
O Degrease		
Transport to Spotfacer	40	
Await Spotfacing		
O Spotface		
Inspect		These four items now eliminated by re-designing the spotfacing cutter to deburr at the same time.
Await Transport		
Transport to Burring	10	
Await Burring		
O Remove Burr		
Transport to Checking Bay	160	
Quantity Check		
Await Transport		
Transport to Degreaser	170	
Await Degreasing		
O Degrease		
Transport to Inspection Bay	170	
Await Inspection		
Inspect		
Transport to Sub-Store	180	
Quantity Check		Paper work and handling operations eliminated by transporting direct to assembly bay, eliminating entry to Sub-Stores (Production Control have approved this arrangement).
Transport to Bin	50	
Make out Record Card		
Store		
Load to Truck		
Transport to Scales	50	
Quantity Check		
Transport to Assembly Bay	285	

Data Sheet A

Yet there is evidence that Production Engineers in the future will devote more of their time to planning and integrating methods of handling. To-day we concentrate on direct production operations and are primarily concerned with " floor to floor " time. In the future, we will be concerned with " door to door " or through-put time.

The majority of engineers and managers fix their attention on machine tools which are often spectacular and costly. They ask questions when these are not in motion but rarely ask questions if the material being fed to and from the machine is stationary. In fact, many of them think a large pile of work round a machine looks good and is a sign of activity.

But a greater number are to-day beginning to realise that handling and movement have had insufficient attention in the past and they are now making it a vehicle for incorporating major improvements in production methods and systems. Managers in some of Britain's larger factories believe that mechanical handling provides the biggest single opportunity for increasing the utilisation of productive equipment and reducing costs. They claim that the working tempo and overall turnover of their factories is greatly influenced by the degree to which good handling methods are being successfully employed.

RECOGNITION OF TOTAL SAVINGS

Unfortunately, it is not always easy, as we have said before, to isolate or express in terms of financial economies the total savings involved. Nevertheless it has been the experience of many firms that the introduction of improved handling has led to increases in machine or process utilisation and, at one and the same time, this has been achieved with a substantial reduction of investment in materials and work in progress.

I have had access to information at two factories which shows that the volume of production has doubled during the last three years, without an increase of work in progress. I was assured that this state of affairs was to a considerable extent due to rationalisation and improvements in handling methods. In other words—keeping the work on the move.

Economies of this type in a small factory may be of much greater importance than to the large concern because, although the figures are not so big, the immediate effect has a greater impact.

It has been said that work in process is the graveyard of profits, and we have ample evidence to-day that the financing of materials and work in process is becoming an ever-increasing problem to all manufacturers, large or small.

A study of the total cost reduction achieved by many companies because of improved handling methods shows the whole problem

as one of great variety and complexity. It involves investigation of many matters and can rarely be reduced to a simple financial comparison of two methods of handling materials for any one particular move.

In many instances, economies result mainly from the rationalisation of existing methods and systems. This is a factor frequently overlooked—that before mechanisation of handling takes place, invariably modifications of procedures and conditions are imperative.

Yet, in calculating cost savings, many people concentrate exclusively on the number of men who can immediately be released for other work as a direct result of installing mechanical handling equipment. Often they do not fully appreciate the other economies which will accrue.

This outlook, in some cases, retards the application of mechanised methods. For example, I have heard that in some works it will not pay to install mechanical handling equipment because the labour now employed in handling cannot be decreased. The advantages in the reduction of turn-round time for vehicles, the possibilities of using warehouse and dock space more effectively, and increasing the volume of turnover from the factory appears to have escaped attention.

Similarly, the possibilities of a reduction in accident hazards and the indirect economies resulting from the improved outlook of the workmen, who would be operating power-equipment instead of doing hard manual labour, are not yet fully understood.

On the other hand, many examples are apparent up and down the country where firms claim that the indirect economies in their own applications more than justify the capital expenditure for mechanised handling equipment.

There is apparently a difference between a cost saving and a wise investment. The difficulty in reconciling these opposing points of view is to find accurate case studies. Companies shy from being quoted. Even where this is not so, problems arise in arriving at the total cost savings on an accurate basis.

SOME INTANGIBLE BENEFITS OF GOOD HANDLING METHODS

The Report—" Materials Handling in Industry "—lists seventeen advantages which can be secured by British industry as a result of improved handling methods. A copy of these is given on Data Sheet B.

I now want to try to evaluate some of them and to show the effect and influence they have on total costs.

You will notice that many of the examples and illustrations with

ADVANTAGES SECURED THROUGH IMPROVED MATERIALS HANDLING

(1) Reduced indirect labour costs.

(2) Increased capacity of existing buildings.

(3) Improved utilisation of existing productive plant.

(4) Increased volume of turnover.

(5) Reduced volume of work in process.

(6) Improved inventory control.

(7) Enabled operators to work at a consistent level of productivity due to reduction of fatigue.

(8) Promoted greater industrial safety.

(9) Improved outlook of men as a result of their operating mechanised equipment instead of doing hard manual labour.

(10) Detailed study of materials handling encouraged and in many cases enforced improvement of plant and building layout.

(11) Helped the maintenance of quality standards.

(12) Lessened damage to the finished product and work in process.

(13) Conserved skilled productive labour.

(14) Reduced cost of transportation.

(15) Increased capacity of distributive transport.

(16) Reduced loading cost at the shipping point.

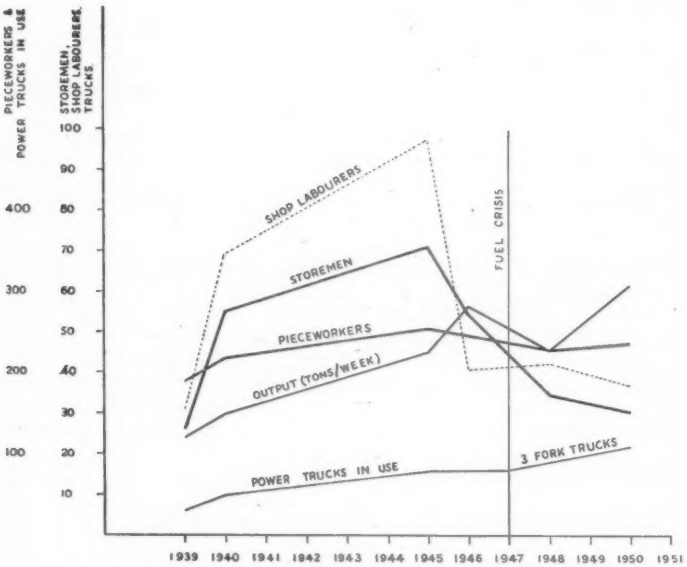
(17) Reduced time or labour at the receiving point.

See "Materials Handling in Industry" Report, which can be obtained from the Anglo-American Council on Productivity, 21 Tothill Street, London, S.W.1.

Data Sheet B

which I am now dealing will contain to a greater or lesser extent economies under one or more of the headings given in your list of advantages.

Now, let's look at an interesting case study contained in your Data Sheet C. It well illustrates advantage No. 1—*Reduced Indirect Labour Costs*. The chart shows the trend of improvement in a works engaged in the batch production of a wide variety of medium-sized machinery. In this instance, production volume has been increased —a better utilisation of factory space and productive equipment has been made—and a reduction has taken place in indirect labour costs.



Data sheet C

The works director told me that he was satisfied that the greater part of these economies resulted from a steady improvement in handling systems and the application of mechanised handling equipment.

I have told you of the difficulties with case studies. Please be kind. Don't tear this one to pieces too quickly. I am sure it will pay for your careful study and perhaps discussion at a later time.

Now—let's examine more closely the next advantage—*Increased Capacity of Existing Buildings*. I have said earlier that when installing mechanical handling equipment, invariably the layout of productive processes and the systems of production control and storage are modified so as to make full use of the mechanical devices. These re-arrangements usually mean that a greater proportion of the floor space of an existing building can be used for productive work. The cubic capacity of the building space is also used more effectively.

Overhead storage and delivery conveyors, fork lift trucks and stacking machines are well-known to you, and ample evidence exists in many works that these are great aids in making the best use of existing factory and warehouse space. While difficult to express as a cost saving, this advantage is of great importance—particularly to the small firm and to those who occupy older-type premises.

Several small factories who have surveyed and made modifications to their layout report that by using inexpensive gravity chutes, roller conveyors, monorail hoists, etc., they have made useful economies and have also found ways and means of making better use of their factory space.

Now advantage No. 3—*Improved Utilisation of Productive Capacity*.

The means of getting material or components to and from the machine and the amount of productive time lost in loading and unloading the machine, is sometimes a major part of the overall cost and needs as much thought as the details of functional speeds and feeds.

Several factories claim improvements in machine utilisation and *pro rata* increases in volume of production of as high as 20 per cent. by investing in devices which aid feeding or extraction of the work. Some of this equipment is simple and in other cases relatively complicated, varying from simple chutes, prepositioned air blasts, duplex sliding fixtures, magazine feeds, etc. Some of these attachments are part of the tooling and in other cases, part of the machine tool design.

To illustrate this principle I would refer to Fig. 1.

Here we have an extractor which permits the transfer of one man, reduces accident hazards by more than 50 per cent. and increases the output of the press by 20 per cent.

Another illustration (Fig. 2) shows how the application of simple chutes between machines resulted in a 15 per cent. improvement in machine productivity without any alteration to the machines or tools. Minor improvements as a result of a further study enabled utilisation of similar equipment to be improved, on an average, by as much as 20 per cent.

Many other companies report similar cost savings from the

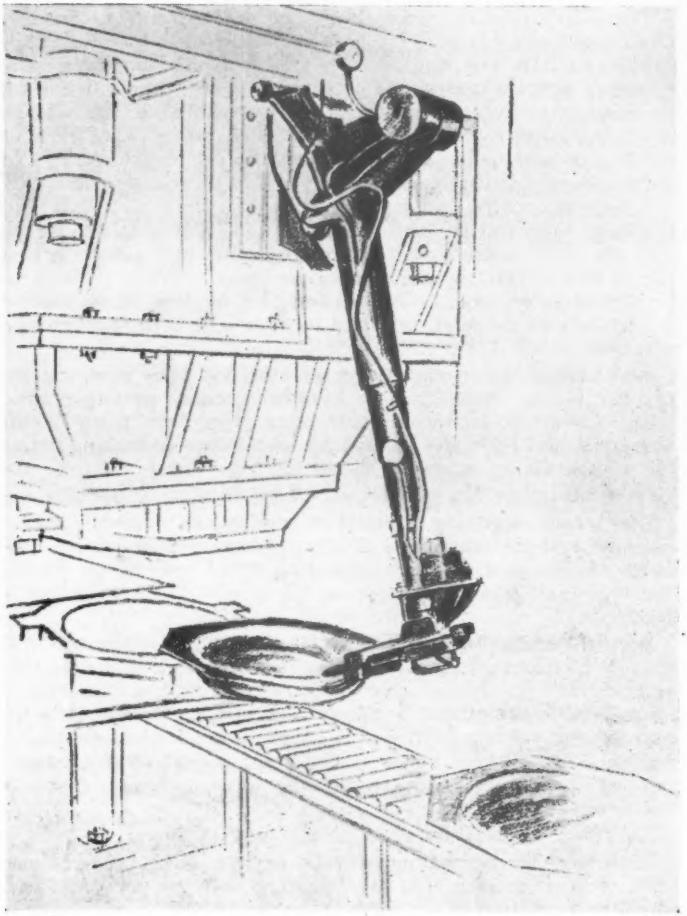


FIG 1

application of modified factory layouts by fixed or portable mechanical handling equipment and accessories. These enabled the production operator to use his machine more effectively and continuously.

FIG. 2

Thus, the productive capacity of men, machines and factory space is increased.

I am not going to attempt to evaluate conveyorised processing plants as used for enamelling and plating, etc., or the use of transfer machines. The value of this equipment where conditions justify it is self-evident. But you will observe that the design of this type of equipment is primarily concerned with mechanical handling.

I would like to show just one example. (Fig. 3)

In many cases the large mass production factories have a greater opportunity of utilising the full range of mechanical handling equipment. So, let us change the picture and have a look at a tool and die shop—a jobbing shop which has a totally different problem. I have an example, where by the application of suitable mechanical handling aids, greater utilisation has been made of expensive machine tools. This has primarily been achieved by the increased application of monorail hoists and special trolleys. The tool and die work and heavy machine attachments are kept mobile and in a condition whereby they can be easily moved to and from or lifted on and off each machine.

It is not possible for me to deal with all of the 17 advantages to-night but I must refer to advantage No. 8—*Mechanical Handling Promotes Industrial Safety.*

The annual reports of the Chief Inspector of Factories show that the handling of materials accounts for 1 in 3 of all reported accidents. What a surprising figure ! I have set out these facts on Data Sheet D. Now, these figures do not include accidents in mines, docks and warehouses, etc. Obviously, handling hazards in the mines and docks are far greater than in our factories.

On the same sheet are shown figures of a sample factory. This company further investigated handling accidents and undertook a methods improvement programme. You can see the results by

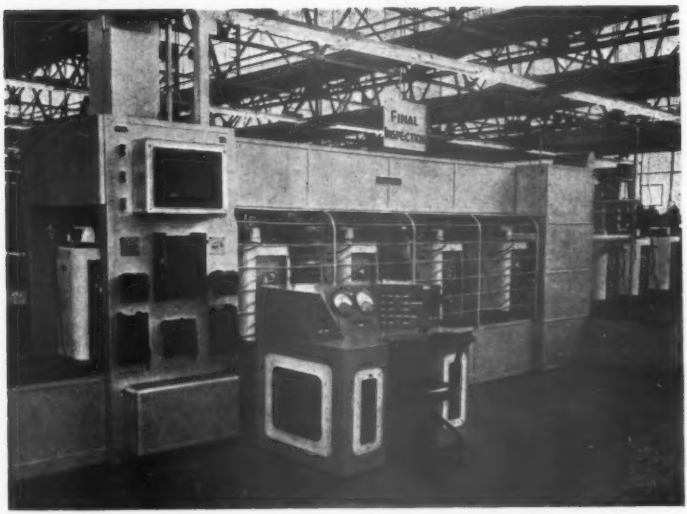
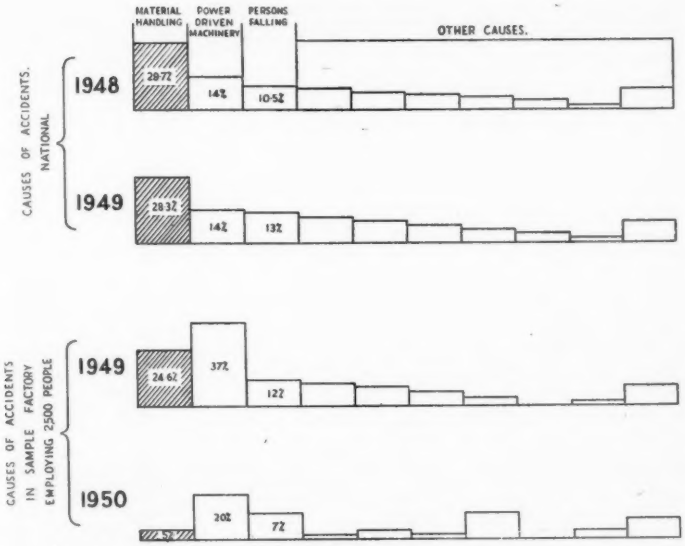


FIG. 3

This conveyorised test equipment is used for inspecting and testing washing machines. It receives work from the assembly lines. The motor leads are connected to the travelling bus-bar system and from then onwards the whole process is automatic. The machine is filled with water, the motor is started and put through a series of tests, and eventually the machine is automatically disconnected, the water discharged and the machine ejected down a gravity chute to the Packing Section. This device speeds up the through-put, conserves factory floor space, ensures a uniform testing standard, ensures synchronisation of speed with assembly operations, and, of course, is a great saver of labour. It is a good illustration of planned, mechanised handling.

MECHANICAL HANDLING IN INDUSTRY



Data sheet D

comparing the 1949 and 1950 figures given in the lower half of the data sheet. A reduction was made in accidents caused by handling, although production volume *increased* by 25 per cent., and what is more, during the same period lower costs were recorded for the handling of materials.

These, of all facts, confirm the value of the application of effective mechanical handling equipment.

My investigations lead me to believe that a large proportion of accidents recorded under power-driven machinery are also due to handling. I have analysed these in one factory and find that the hand-feeding and extraction methods used on many of their power machines are the primary causes of accidents under this heading. Again, this aspect was tackled and great improvements are already apparent. Accidents under this heading were reduced and, in every instance where changes were made, it has resulted in a speeding up of the productive process. The machines and work people are producing more work under safer conditions. A new slogan has been coined—Safety Fast.

Before I conclude, there is just one aspect I would like to bring to your notice—one which I believe has been overlooked up to now.

MECHANICAL HANDLING AND FULL EMPLOYMENT

Full employment means that we must provide conditions suitable for the successful use of people of all types. While it is an unpleasant thought, we must also face the fact that under a possible war economy, a large proportion of our young adults would be absorbed in the armed forces or defence services.

With the proportion of older persons in Britain rapidly rising, their useful employment has become an urgent economic problem. We must make better use of the " over 40's." (Or should it be the under 90's !)

The Papers of the Royal Commission on Population show that in 1947, 10 per cent. of the population were over 65, and it is anticipated that this figure will steadily increase until, in 1977, it will be up to 16 per cent. At the same time, the element under 40 will probably decline.

There are also many physically disabled people for whom productive work must be found.

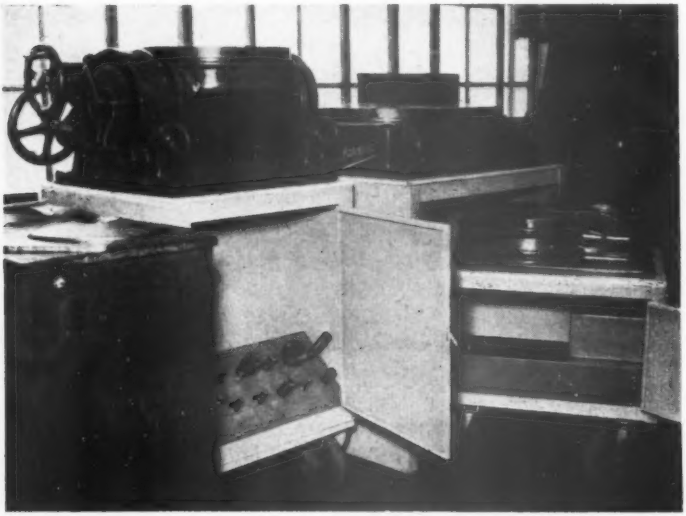


FIG. 4

This shows heavy work tables stored on specially designed trolleys. These enable attachments to be brought to and from the machine quickly and safely. When not in use, the attachments are stored in a tidy manner.

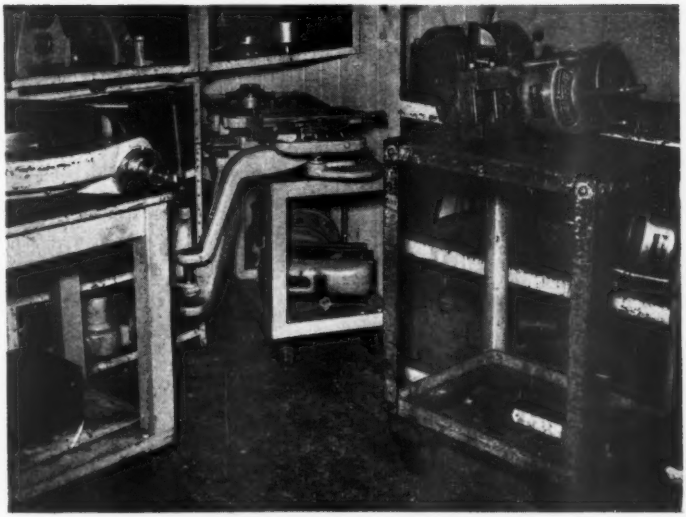


FIG. 5

This illustrates other special trolleys designed for work tables and attachments, so that these likewise can be rendered fully mobile.

British industry employs a large number of women and it is possible that this number will have to be increased still further. All these people must be given the opportunity of participating in the productive life of the community. If necessary, industry must adapt its practice so as to include a larger proportion of them, and well-applied mechanical handling can make a valuable contribution in this direction while, at the same time, assisting in the reduction of manufacturing costs.

CONCLUSION I have endeavoured to evaluate some of the intangible advantages resulting from improved handling methods in factories. We have seen that our cost systems are not adequately showing the full effects of the total handling costs. I have attempted to present evidence that great economies are being made by the use of mechanical handling equipment. And, finally, we can say with some assurance that this profitable field of investment will be still further explored by our Production Engineers.

DISCUSSION

Mr. L. W. BAILEY, who opened the discussion, said that he recognised that in starting to prepare his paper, Mr. Dimmock must have been presented with an immediate problem about the level on which he should pitch it. On a subject which covered such a wide field, he could have spoken on very general lines, but instead he had chosen to illustrate the problem by reference to a specific field, and in doing so he had succeeded in drawing from that field principles which had a very general validity.

It might have been desirable, perhaps, if Mr. Dimmock had emphasised rather more than he had done the fact that materials handling was an aspect of Production Engineering. In his own experience, he had found that some managements who had perhaps visited America had come back impressed—as was everybody who went there—by the great advantages to be gained by the introduction of mechanical appliances, and had then issued instructions for mechanical handling equipment to be installed, doing so without reference to the fact that mechanical handling must be

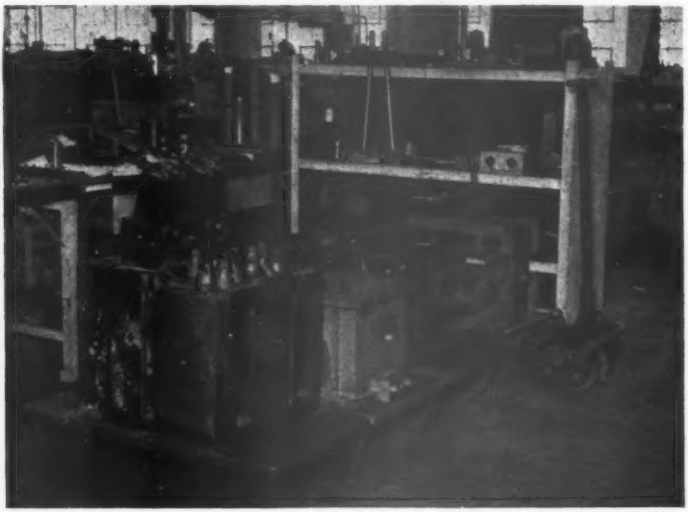


FIG. 6

The tool and die work also is at all times stored in a condition whereby it can be readily rehandled or transported.

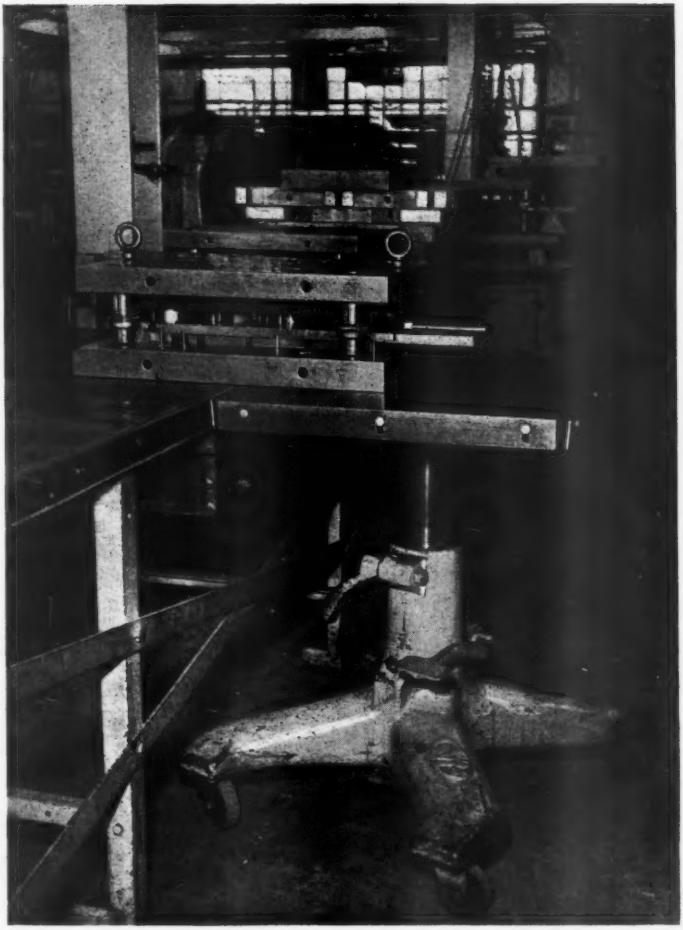


FIG. 7

This is another illustration showing how heavy tools or dies are handled from bench to bench or from machine to machine.

integrated with the general production organisation. This was a matter which Mr. Dimmock had quite rightly emphasised. On many occasions recently, he had himself found that, in attempting to solve mechanical handling problems, his first task was not to solve what appeared to be a specific handling problem, but to solve problems in layout and general production procedure. Therefore, he felt it was necessary to emphasise that mechanical handling was not a new or special technique, but was a technique of the Production Engineer, to which very much closer attention must be paid in the future.

Mr. Dimmock had drawn attention to the difficulty of analysing costs in order to produce a statement which would show exactly what costs were likely to result from the introduction of mechanical handling equipment; he had also mentioned the difference between a cost saving and a wise investment. A wise investment was very largely a question of approach, and that was why such papers as that of Mr. Dimmock did much to encourage an attitude which led to a sound approach to these problems in the minds of some managements.

A further matter upon which Mr. Dimmock had touched was the question of the utilisation of the machines and the utilisation of labour. The question was often put, "What is likely to be the labour reaction?" The case which Mr. Dimmock had postulated was that of a growing economy. That growing economy might be a war economy—it was to be hoped that it would not be—or it might be a growing economy in which it was desirable to obtain the maximum utilisation of labour. This matter was a difficult one to deal with in a particular factory. A given worker in a particular factory was concerned, very properly, with the economic consequences to himself, and with what would happen to him as an individual if his labour was superseded by the introduction of mechanical equipment. It would be very helpful if Mr. Dimmock could further elaborate his views on this aspect of the problem.

One of the functions of an opening speaker in the discussion was to fire bullets at the lecturer in order to get the discussion going. Having worked under Mr. Dimmock, he knew how dangerous it was to fire bullets at him; so he would leave that job to others. The only request he made was that Mr. Dimmock should give a little more information about his views on the extremely important question of the attitude of labour.

Mr. Dimmock replied that he had purposely left out labour problems because he had been asked to speak on the influence on costs; but, of course, labour could not be left out of consideration, and it was a very difficult matter to put into its right perspective. Obviously any form of mechanisation was best undertaken when there was an expanding market for the product and this applied

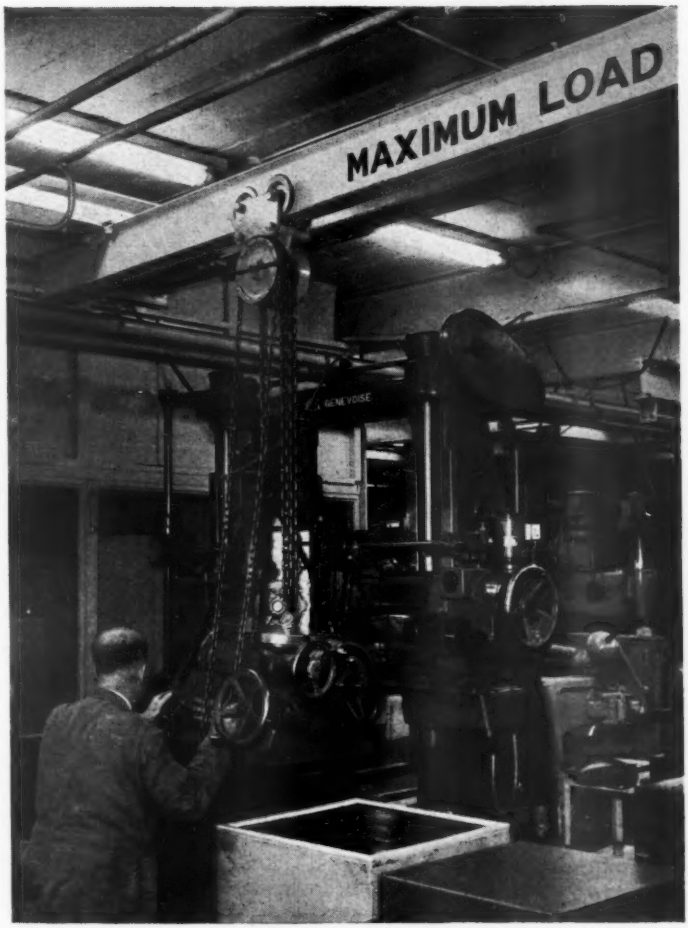


FIG. 8

Each major machine tool is serviced with individual beams and hoists. The utilisation of valuable machine tool equipment has been increased by approximately 10 per cent. by adopting better handling methods for loading work or attachments on or off the machine. The use of individual hoists in place of or to supplement overhead cranage invariably allows 5 to 10 per cent. increase in existing machine utilisation. (*Figs.* 8 *and* 9.)

whether the mechanisation consisted of a machine tool, a handling device or even a new factory. Usually one did not invest money unless one saw the need for an expansion of output.

In a case where the output was not going to be expanded and where, consequently, any useful device that was introduced would replace labour and mean somebody going out of the door, there was no need to ask the question " What will be the reaction of labour ?" Any person's reaction would be not to like it, to kick up a fuss about it and to ask the reason why. In such conditions, it was always very difficult to explain why. Many people thought that labour was the most flexible element in the manufacturing scene. It was, but that did not mean that it could be simply hired and fired without any consideration.

Fortunately, it was not possible today to order a mechanical device and get it delivered tomorrow. Sometimes delivery could not be obtained in less than a year. He suggested that this gave ample time for those ordering the equipment to find out and legislate for what was to be done with the labour that might be displaced. Every establishment had a labour turnover problem. There were very few companies in this country which did not have more than five per cent. of their staff displaced per annum and there were few companies which could make a five per cent. per annum method improvement. The average for the light engineering industry was a labour turnover of approximately 25 per cent. per annum and very few companies were making more than a five per cent. per annum method improvement. Provided that they took action early enough and did something to meet the situation, there would be no labour displacement problem.

There were certain industries, which were not under discussion to-night, in which there was a system by which a gang was but on the job, and whatever was done about mechanisation the same gang had got to stay on the job. But he did not intend to be drawn into a discussion on this ; he would prefer to leave it to the Dock and Harbour Board to solve the problem ! They had allowed these men to run round and do manual humping for years when they could have employed better devices. They had sown the seeds of their own problem ; let them solve it ! But even in that case there was a solution. As he had indicated in his remarks, one could employ mechanical devices and use the same labour without there being any displacement and could still get economies in turn-round time, as well as other advantages.

Mr. Bailey's remarks had reminded him of a point which his wife had made on his return from the United States. On being told about mechanical handling problems, she had said, "What is it all going to lead up to ?" At first he had said, " I really don't know "; and then the milkman had come to the door and the

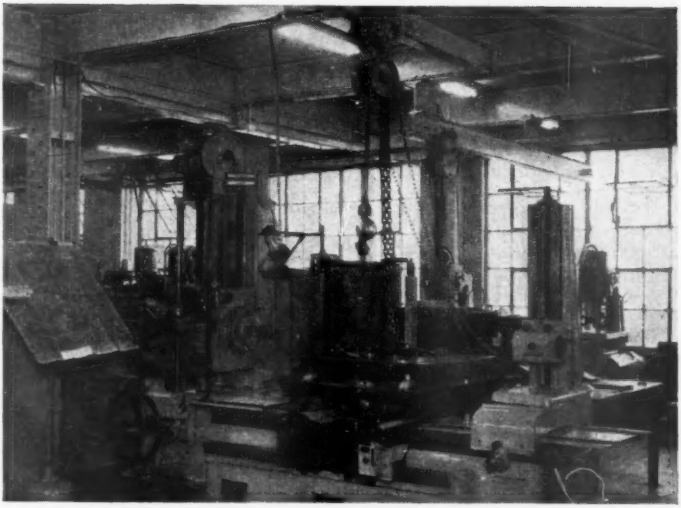


FIG. 9

milkman's arrival had set in motion a train of reflection. Twenty years ago, he had reflected, the milkman started at four o'clock in the morning, filling up the churns, getting out a three-wheeled cart with iron-rimmed wheels and pushing it from street to street and house to house, measuring out milk from the churn and delivering it. Then he would return to the dairy and snatch half an hour for breakfast, and then repeat the process of filling up the churns, etc., throughout the day until four o'clock in the afternoon—a working day of ten or twelve hours. This went on for seven days a week, winter and summer, except when the man was ill. This had been the lot of the average milkman twenty years ago. At the present time, the milkman had a powered vehicle ; the process had been rationalised ; he made a delivery only once per day ; he had an eight-hour day ; he had unit loads and had not to measure out the milk.

This was a perfect example of materials handling, an example of rationalisation of the process and mechanisation of the manual work. What had the milkmen got out of all this ? They had got an eight-hour day instead of a twelve-hour day. They had less manual work. The job could be done by a man who needed an open-air job but who did not necessarily need to be as strong as a mule or a

horse. Undoubtedly the milkman was better off. This was only one isolated example which was spread over many years. He was convinced that the application of mechanisation would result in a similar story in many other fields.

Professor JOHN R. IMMER felt that the most important thing that could be said on the subject had already been said by Mr. Dimmock. In a year or so a great deal of what had been said this evening would have been forgotten by those who had heard it, but there was one thing which he hoped would be remembered—namely, the reference to rationalising the process. That was the heart and soul of materials handling. He had been very cheered to hear Mr. Dimmock start by saying that materials handling was more than

FIG. 10

It was earlier said that the rationalisation of existing methods could show great savings without, in some cases, mechanising the handling. In this jobbing shop, this principle was studied and a solution was found which eliminated a large percentage of unnecessary movement by the machine operator through the provision of specially designed work storage cabinets against each machine, for housing cutters, attachments, measuring and clamping equipment. This, together with the principles outlined earlier showing how the work and machine attachments can be better handled, has resulted in machine utilisation on certain equipment being improved as much as 15 to 18 per cent. You will see by these illustrations that very worthwhile economies are being made in some jobbing shops.

the utilisation of equipment, and that a great deal could be done to improve handling without installing any expensive equipment at all, simply by changing layout and improving the motions around the machine. As he had often done before, Mr. Dimmock had hit the nail right on the head.

There was not anything much more important that could be said about materials handling. It was a Production Engineering process. One could not approach a handling problem unless one knew what the process was and unless one could analyse it.

This brought him to another point. In order properly to take care of a materials handling problem and arrive at an answer, one had to consider a tremendous mass of information. The more complicated the process, the more information there was that had to be considered. This made even more important the preparation of the forms such as Mr. Dimmock had shown. They were a means by which one could bring together on paper a tremendous mass of material and ascertain human relationships on the basis of that mass of data.

There were two points on which Mr. Dimmock had not touched, perhaps because of lack of time, on which it would be useful to have some further clarification. The first was the part which the cost accountant should play in tackling materials handling problems and what the materials handling engineer and the Production Engineer should know about cost accounting, in order to approach these problems more intelligently from the costing standpoint. The other point was the part which the workers themselves played in developing these new methods and ideas. He strongly suspected that in Mr. Dimmock's organisation they had played a very important part.

Mr. DIMMOCK said that he had not wanted to be too pointed in his criticism of cost systems and their lack of analytical detail on 50 per cent. of the costs. Sometimes one tried to reduce the costs in a painful way—i.e., by just telling somebody to cut down by 10 per cent. That was the best managerial technique yet discovered for doing something about it! Nevertheless, there was a grave omission which ought to cause the accountant to give more considered attention to this problem.

He was not going to criticise the accountant. It was no good just keeping figures unless they were used. Up to now the accountant, he thought, had not been satisfied that the Production Engineer would use the figures. Any man who felt that he wanted more figures should get together with his accountant and explain the problem. The accountant should be taken into the shop and told, "This is the problem. How do I evaluate it?"

Mr. Dimmock did not know how this was to be done. He could say how a job should be done in the shop, he could evaluate it in

his own mind, he could convince his chief about it and get him to spend money on the thing ; but he could not tell the members of the Institute of Cost and Works Accountants how to do their job. He was, however, certain that something could and should be done. He knew, also, that the President of the Institute of Cost and Works Accountants was very much aware of the problem. In the Report of the Productivity Team on mechanical handling, and again at the Summer School which the Institute had held at Oxford, the President had indicated to cost accountants the need for the accountant to understand the engineer's problem, to get into the factory and see it personally, and to help the engineer in regard to those problems to which Professor Immer had referred. It was up to each Production Engineer to see that this was done in his own undertaking. It could not yet be done from outside.

On the question of the help received from the workers, he hardly knew what to say. In his own organisation there were very close relations with the workpeople through the supervisory structure, and it was very difficult at all times to find out who originated an idea. It was very rare that one was able to find the man who first had a really worthwhile idea. What happened was that a sort of germ of an idea grew and percolated through the factory and before one knew where one was, three or four people would be talking about it ; then other people worked on it and improved it and did something about it. It was very difficult to find out who originated it. He would say that in a sense all the people contributed in some way to all the ideas that came forward.

Mr. SMART, mentioning that he was concerned to some extent with the design of special purpose mechanical handling equipment, said that Mr. Dimmock had drawn attention to a number of points which perhaps did not get quite enough attention in this country.

The first point to which he wished to refer was the difficulty, when considering whether some piece of mechanical handling equipment or special mechanised processing equipment should be installed, of estimating what savings in costs were going to be made as a result of its introduction. There was, he felt, one way in which this problem could be put as distinct from showing the saving merely as wage saving. Normally speaking, there were at present highly mechanised shops with large oncosts. Those oncosts were worked out on the basis of 100 per cent. production. The way in which he looked at it was that if a machine or mechanised equipment could be installed which would increase the production of the shop to 110 per cent., then one would be recovering the normal shop oncost on the original 100 per cent. production and getting an extra 10 per cent. production free.

Cost accountants might take exception to this, but he thought

that the enormous advantage of continuously moving equipment was in fact reflecting a saving of cost of that order and not the mere saving of perhaps one or two operators.

Another point which had arisen in the course of discussion was that of labour relations on the introduction of mechanised equipment. His own observations had rather surprised him in that he had found very frequently that the introduction of a piece of automatic machinery which set the pace, instead of a rather arduous hand operation in which the operator had to do a lot of lifting and set his own time, had been welcomed by the operators. He thought that in the modern light manufacturing industries, where there was not a long and unhappy tradition of bad labour relations, the ordinary operator was very glad if a machine set his pace for him and he did not have to watch the clock to find out whether it was time to get on with the next one !

It had been emphasised in the lecture and in the discussion that the correct approach in the mechanisation of handling was tied up with a streamlining of the whole manufacturing process. He would like to utter a word of warning against a rigidity of outlook which was too prevalent in this country on the subject of brick walls. Any number of good schemes had been condemned because there was a brick wall in the way, as though a brick wall were something sacred that could not be knocked down. In many cases the cost of knocking down the wall and rebuilding it twenty times would be fully justified in comparison with the saving that could be effected by the projected scheme. He thought that much more thinking needed to be done about such things.

Mr. DIMMOCK replied that he agreed with everything Mr. Smart had said, and there was no need for comment.

Mr. GAMMON thought that one point which had been made by Professor Immer had not been fully appreciated by Mr. Dimmock. It was that if one spent money on improving the handling and thereby saved time, unless one could show clearly in £ s. d. the results of that saving to the board of directors, it might well be lost. Mr. Dimmock rather took the attitude, " It is nothing to do with me ; it is the accountant's job." But what did the accountant do with regard to it ? He pushed handling into the overheads, and therefore one did not know how much was being spent on handling.

Personally, he agreed with the implication of Professor Immer's remarks, that it was the Production Engineer's job in this case to direct the accountant to segregate the indirect costs and turn them into direct costs so that the problem could be seen in terms of cash. Unless this was done, the saving effected by improved handling methods would not be shown up clearly.

Mr. DIMMOCK said that the problem of accurately evaluating in pounds, shillings and pence the savings resulting from the installation

of handling equipment was one to which Production Engineers continually returned. Throughout his talks he had tried to show how complicated it was to arrive at the true cost and the true savings of such an investment. The general experience was that these devices materially aided the turnover of a factory and enabled better use to be made of existing equipment ; but those factors were very difficult to evaluate and express under normal costing systems.

Nevertheless, there were many cases where isolated pieces of equipment could be dealt with precisely as Mr. Smart had suggested, namely, they could be turned into direct costs. But the effects were much greater than the sum total of the individual factors that could be calculated—and this had been the whole theme of his paper. He could give examples of plants where they had literally doubled the turnover in the same factory space and with the same productive equipment by rationalisation of the process, and the expenditure of a relatively small capital sum on handling equipment. But no accountant would be prepared to acknowledge all those savings as being the outcome of the handling equipment ; he would say that they were the result of general reorganisation.

There was no better way to make a business pay than by increasing the turnover. It was all very well to make an individual saving and to present oneself to the board of directors as a very bright boy who bought a machine and saved £10 a week ; but when one got the cost statements, it might be seen that not much better business was being done than in the previous year, whereas another company had doubled its turnover. The increase in turnover was the secret of the whole thing.

In connection with the difficulty of making an evaluation, he could only recommend them to the Report " Materials Handling in Industry " and refer to the chapter on costing and the advice given therein to cost accountants to segregate costs and help to ascertain these things more accurately.

Mr. AUSTIN asked Mr. Dimmock whether he agreed that cost accountants generally were trained to be too exact in regard to the information which would support a project. Personally, he felt that the accountant should be prepared to have a broad opinion in the same way as the Production Engineer had. Mr. Dimmock had indicated that the Production Engineer would know broadly that a certain thing was the right thing to do. Surely the cost accountant had a mass of data and experience at his disposal which would enable him to evaluate a minimum saving, and then give a broad opinion on the remainder in support of the Production Engineer's contention that the expenditure was worth while—or, *vice versa.*

Mr. DIMMOCK said that he agreed partially with Mr. Austin's remarks.

Mr. THORP assumed that before expending money on the introduction of any new materials handling scheme, Mr. Dimmock would try to form some idea of the annual saving that would be likely to result, and to equate that against the cost of the equipment and the alterations that would have to be made. He asked Mr. Dimmock to indicate how many years he would allow for the amortisation of that cost in order to make an effective move on behalf of his company. He raised this point because, whereas it was generally possible to legislate fairly accurately for machine tools, with materials handling the changes were coming about so rapidly that only those people with a fairly lengthy experience of the subject could give an idea as to whether the cost should be amortised in twelve months or two years, or something of that order.

Mr. DIMMOCK replied that if it was possible to evaluate all the advantages, many of which were very difficult—he would guarantee that in the main 50 per cent. of them would be present in any installation—then the equipment could be written off in two years. The question was how to evaluate factors which varied from company to company. In his own company, factory space was a dominating factor ; anything that would help to conserve space would be of greater importance to his company than, perhaps, to another company. If he could get 10 per cent. more output from a shop, he would evaluate that as a big factor, particularly if that one shop was a bottleneck for the whole works, and an increase in turnover from it would enable an expansion of the overall turnover of the works. If there was one bottleneck and it would cost £10,000 just to gain some space which would enable that bottleneck to be remedied, so that the turnover of the rest of the works could be expanded, he would make an evaluation which would be quite out of proportion to that made by some other man in another company.

There was no common basis, and each man had to govern his own business. Judgment entered into the question. Management and Production Engineering was not yet an exact science ; it could not be put into a textbook and read out. If it could be, none of us would be Production Engineers ; little boys and girls would do the job !

Mr. OPPENHEIMER felt that the Production Engineer often expected the accountant to do a job which he himself could do. Surely the best way of dealing with the matter was to sit down together with the accountant and discuss the job with him. Production Engineers were sometimes apt to regard the accountant as a sort of magician who could get an answer out of a bag of tricks,

whereas the Production Engineer himself had one half of the story and the accountant the other half, and it was a question of fitting the two together.

In the Report of the Productivity Team, there was an instance where some material was held a very long time on the floor owing to the poor system of paper work. In very many cases it was found that a great deal of the movement that was taking place was due to the same cause.

An important question was why a material was being moved and what controlled its presence at any particular point at a given moment.

Mr. L. W. BAILEY said that originally he had raised the question of labour relations simply because, some two or three years ago, he had had a discussion with Mr. Dimmock on the matter, and Mr. Dimmock had then made some very interesting observations which he had hoped to hear developed.

In his reply this evening, Mr. Dimmock had brought out the point that in planning the introduction of equipment one must at the same time plan what was to be done with the labour. That was the point which he had sought to have clarified. If the situation were left unplanned, then when the equipment arrived the labour would be disposed of in an inadequate manner, thereby creating bad labour relations, or the equipment would be installed and nothing would be done about the labour factor. The point which Mr. Dimmock had made, quite rightly, was that when planning new equipment—and not at the point when it arrived—there should also be planning about what was to be done with the labour that was to use the equipment or to be displaced by it.

Mr. THOMPSON asked for some further information about the charts which Mr. Dimmock had demonstrated concerning the introduction of trucks and other handling equipment. Was the purpose of the curves to show that the introduction of fork-lift trucks had been the major factor in the rather remarkable changes, or had there been some other factors, somewhere before the fuel crisis, which contributed to the changed position?

Mr. DIMMOCK, in reply, said that the chart in question had been provided by the manager of a factory engaged in batch production machine manufacture. About 1942 the manager was busily reorganising his storage area and his systems of production, and it had taken him a long while to carry out that reorganisation in total. It was for that reason that he had not decreased his shop labourers or storemen earlier. He had been getting himself into a condition in which he could use effectively fork-lift trucks once he decided to buy them. He had rationalised his systems of production and the layout of his factory over two or three years before introducing the fork-lift trucks. On introducing them, he said, " Now that I have

bought these vehicles, now that I have spent money and time in getting the conditions right, I am going to decrease the number of shop labourers forthwith." That manager had planned, he had ploughed the ground, he had put in the seed, and then when the time came he sought his harvest.

Mr. THORNTON asked Mr. Dimmock how it was possible to estimate accurately the saving of any new machine tool. Surely it could only be hypothetical, since there would not be any previous experience of its mechanical efficiency. There was only the salesman's word for its performance—and everyone knew all about a salesman's words in selling a thing ! It was, however, very difficult to convince a board of directors that that actual saving would be produced. If the saving was not forthcoming, the accountant came along and said that the machine tool should never have been bought. What, he asked, must one do to convince someone that the equipment would save a certain amount ? How was one to convince the higher authorities that such a tool was essential ?

With regard to the problem of labour displacement, it was his experience that any new machine tool probably saved some labour, but it also entailed the employment of other labour, namely, the maintenance engineers. It was therefore a matter of convincing the people concerned that it was not entirely displacement, but rather re-employment, of higher grade labour to service the machine.

Mr. DIMMOCK felt that if ever there had existed any difficulty in " selling " to boards of directors the need to buy a machine tool, that difficulty certainly did not exist at the present time. One had only to look at the order books of machine tool manufacturers to see that there were very many able managers who could sell to their boards of directors the idea of buying machine tools. He could not believe there was any difficulty in selling the idea that money should be spent on machine tools.

There was, however, some difficulty on some occasions to convince oneself of the savings that would result from the investment. Most Production Engineers had experience in evaluating by judgment and other factors the advantages or otherwise of one particular type of machine or another. As professional men they had collectively a good deal of experience in evaluating machine tools, and when they had had more experience and were able to evaluate more accurately the mechanical handling equipment, they would be that much better off.

Mr. R. E. LEAKEY said that his feeling about mechanical handling was that it was really just another part of the process. He felt that where they went badly wrong in this country was in regard to the amount of raw material that was stuck at the beginning of the line and the amount of finished work that was cluttered up at the end of the line. It was necessary to put mechanical handling in its

right perspective. The machine tool men could sell machines that would do six operations without anyone touching it, machines that were fitted with wonderful fingers, and so on. What was necessary was to stop spending a lot of money on mechanical handling equipment just to manoeuvre the stuff around the factory for fun, and to get down to the basic fact that in came the steel, it went straight on to the machine, and when it was finished at the other end, it must be got rid of.

He felt that there was a great deal to be said for having the man move rather than the machine or the material. There was much to be said in the economics of production for having a machine that was set up constantly for one job.

There was no real difficulty in getting mechanical handling devices ; the difficulty was always to make use of them sufficiently once they were obtained. He did not think Production Engineers should concern themselves as to how to prove to the management or the cost accountant how it could be done. The crux of the matter was to get a bigger turnover out of a given area. He regarded mechanical handling as another machine tool in the process.

Mr. DIMMOCK said that the purpose of all equipment primarily was to reduce the throughput time, and thus to speed up the turnover value that one could get from a given productive unit. The more the whole thing was integrated and the systems of production rationalised to that end, the better. The degree to which this could be done would depend on the circumstances of a particular business and on the personal " know-how " of the Production Engineer concerned. He agreed with Mr. Leakey.

Mr. J. E. BURNETT, in moving a hearty vote of thanks to Mr. Dimmock, said that he had been most interested in the paper and in the very apt illustrations of the principles of mechanical handling which Mr. Dimmock had given in his replies to the points raised in the discussion.

The term " mechanical handling " was in some ways fast becoming a hackneyed expression. Really, mechanical handling was as old as time ; in fact, the very word " mechanical " was indicative of the saving of time by mechanical means.

Considerable emphasis had been placed in the discussion on the means by which the savings could be measured, and this was obviously a very difficult problem. In his own company, he had at one stage wanted to improve the handling of material and had contemplated the fork-lift truck ; he had endeavoured to evaluate how he was going to justify the purchase of the equipment, but had found it impossible to do so. As Mr. Dimmock had stated, it was absolutely a question of judgment. In the case of his own firm, the decision had been taken and the truck bought. Over a period of time, by effectively using the truck, there had been an improvement

in turnover (not wholly because of the fork-lift truck but because of other methods), and it had been possible to handle the increased turnover, which he would conservatively estimate at 50 per cent., with the same labour force. He was quite sure that without the use of the truck it would have been necessary considerably to increase the labour force. All this was something that one could measure oneself when walking round the factory and seeing what people were doing, but which one could not put down on paper. Men who were managing factories had got to take their courage in their hands and say, " That is the right way to do it " and then put in the equipment.

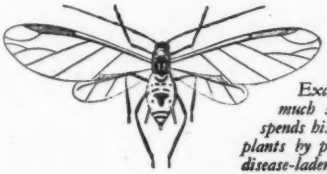
He thought that for far too long managements had, generally speaking, been too conservative. A little time ago he had been talking to a friend of his who had developed what he called a " bantam tug." It pushed or pulled barges on canals. This was an extremely interesting development of mechanical handling, since obviously it would replace men, it would replace horses and it would replace the men who had to maintain the horses and the men who had to maintain the towing paths. His friend had experienced considerable difficulty in persuading people to change over to this new method of transport, and some of the replies given to his friend were typical of the conservative we-cannot-do-it school of thought. He was sure that in time this new method of transport would be used, and although it was outside the field of engineering, it was nevertheless an interesting application of mechanical handling.

He asked the meeting to express its wholehearted thanks to Mr. Dimmock for a very interesting paper and for his very illuminating and interesting replies to the points raised in the discussion.

The vote of thanks was passed with acclamation.

Mr. DIMMOCK, in expressing his thanks, said that it had been a privilege to represent the Institution in the Productivity Team which had gone to America, and it had given him much satisfaction to see the way in which the Institution had used the knowledge that had been thus gained. It had been a great pleasure to him to talk to the London Section.

This is the tale of Samuel Small
Who hadn't got no voice at all,
He croaked and wheezed with sad despair
"Won't someone try to clear the air?"
The gaffer heard of Samuel's plight
and thinking hard that very night,
said "Spenstead is the name, they say,
for clearing dirt and dust away. . . . . "
. . . .now Samuel works in air that's clear
from him a different sound you hear. . . .
Sam, working at a furious pace
Sings tenor to the foreman's bass.



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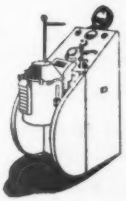

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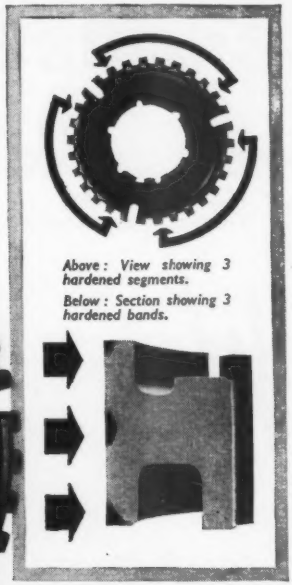
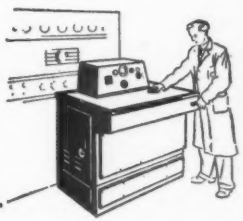


Above: View showing 3 hardened segments.
Below: Section showing 3 hardened bands.

the "machine tool" approach to PRODUCTION HARDENING

Component ..... Synchromesh gear box clutch sleeve.
Dimensions ..... 3.34" diameter x 1.3" width.
Material ..... EN 8 0.4% C steel.
Hardened Area ... 3 x 90° segments in three bands.
Condition ..... Clean, decarb-free surface.
Distortion—Nil.
Hardness—Rockwell C47-57.
Production..... 3500 parts per 44 hour week.
Equipment ..... **Birlec 20 kW automatic H.F. induction heater.**



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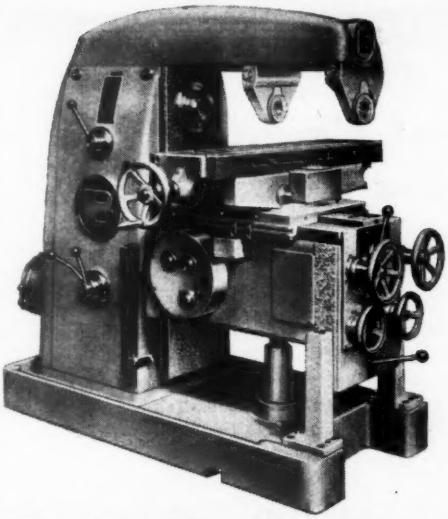


BIERNATZKI

FULLY ELECTRIC · HORIZONTAL · VERTICAL & UNIVERSAL

PRODUCTION MILLER

Table Dimensions
44″ x 11½″ to 70½″ x 16½″
Longitudinal Traverses
27¾″ to 44″
Cross Traverses 9¾″ to 14¾″
Vertical Traverses 16¾″ to 17¾″
Spindle Speeds - - 18
Spindle Speed Range
30 - 1,500 r.p.m.
Quickly detachable Feed Box

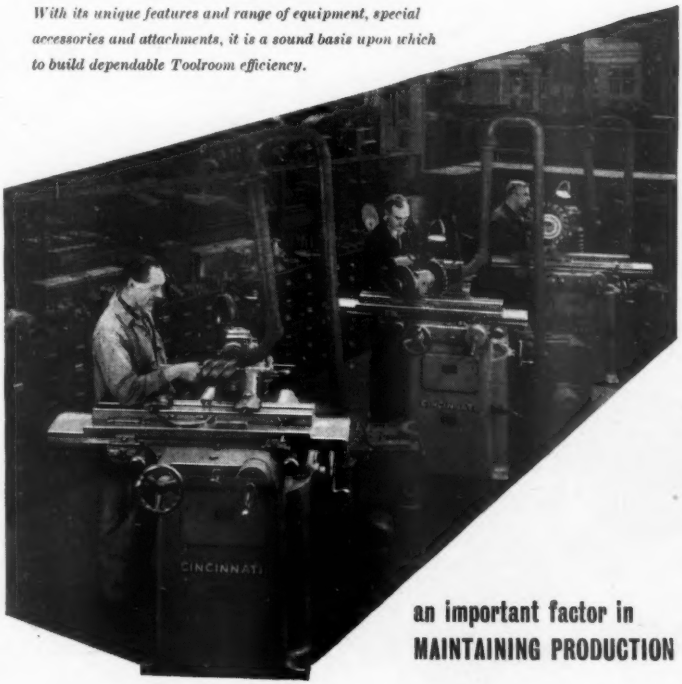
Sole British Agents

SYKES machine tool company limited

TERMINAL HOUSE · VICTORIA · LONDON · S.W.1
SLOANE 2272 (3 lines)

Failure to ensure that cutting tools are properly sharpened and facilities are available for servicing them will seriously affect the smooth running of any production programme. When considering this problem, it is necessary to bear in mind not only the quantity of work to be handled, but the diversity of operations involved and thus be sure that the Cutter Grinders installed are capable of dealing with all types of work required of them. In this respect, the Cincinnati No. 2 Tool and Cutter Grinder has proved its all round excellence as an adjunct of production units where the range of work is continuous and complex. With its unique features and range of equipment, special accessories and attachments, it is a sound basis upon which to build dependable Toolroom efficiency.

efficient TOOL SHARPENING



an important factor in MAINTAINING PRODUCTION

CINCINNATI NO. 2 CUTTER & TOOL GRINDER

CINCINNATI MILLING MACHINES LIMITED, TYBURN, BIRMINGHAM
Sales Representatives for Gt. Britain and Northern Ireland: CHAS. CHURCHILL & CO. LTD., BIRMINGHAM, 25.
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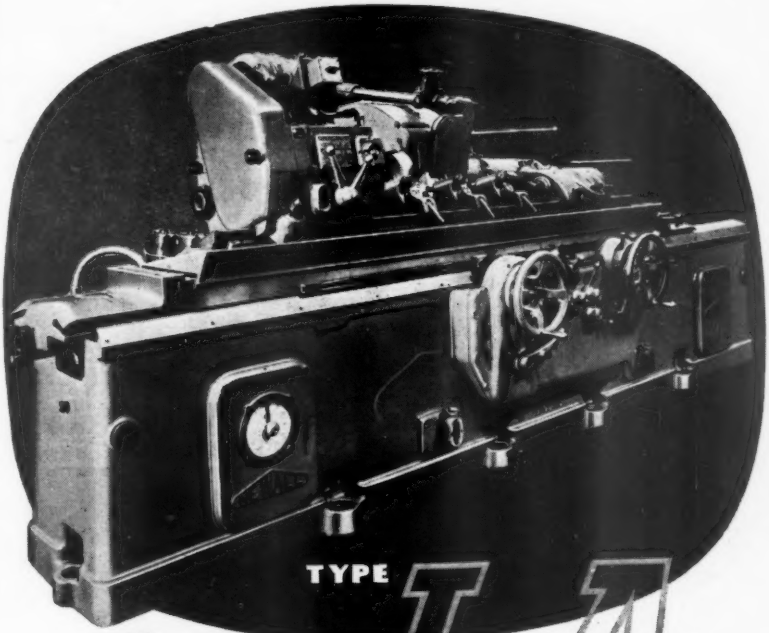
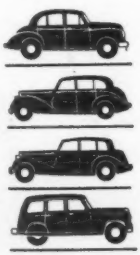


Grinding machine

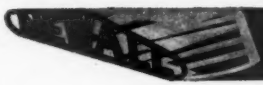
NEWALL "LA" GRINDER CAPACITY 16" x 60"



This Grinder, together with the LA Pin Grinder is being used extensively in the automobile industry today for the rapid production of crankshafts. These 2 machines make a complete production line for finished crankshaft production.

The LA Grinder is available in sizes 10" x 16", 24", 36", 48", 60", 72", 84".

We will be pleased to send full data on these and any other machines in the Newall range.



NEWALL GROUP SALES LTD.
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SCOTTISH AGENTS DRUMMOND ASQUITH LTD
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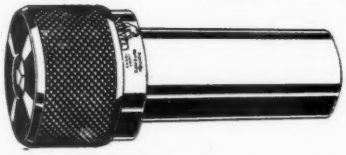
CHUCKS FOR MODERN HIGH SPEED DRILLING PRODUCTION

THE "MARVEL" KEYLESS & THE "ARCHER" KEYLESS DRILL CHUCKS

are designed and constructed to stand up to modern drilling practice. The external design is robust and serves as an efficient casing to protect the internal mechanism. The jaws are protected from damage by the specially hardened boss or cap. The demand for this perfect chuck increases every year, evidence that the leading engineers appreciate its worth.

FIVE SIZES FROM $\frac{1}{4}$in. TO $\frac{3}{4}$in.

ASK FOR OUR CHUCK CATALOGUE 5G



TURRET STYLE "Marvel"

Shanks made solid from body giving short overhang for rigidity and alignment.

Tools quickly changed by hand without disturbing chuck setting.

Made in all capacities and various shank diameters

The "ARCHER KEYLESS DRILL CHUCK

is a correctly designed small size chuck working on the same principle as the "Marvel" which ensures reliable grip and ease of release. It has permanent concentricity and perfect balance for high speed drilling.

TWO SIZES: 0-$\frac{1}{4}$ in., 0-$\frac{3}{8}$ in.

ARCHER SMALL-TOOLS

FRANK GUYLEE & SON Ltd.

ARCHER TOOL WORKS, MILLHOUSES SHEFFIELD 8

EFFICIENT HANDS DEMAND EFFICIENT TOOLS

Every Holman Pneumatic tool is a first-rate precision-engineering job — easy to handle, operate and maintain. All over the world, wherever dependable pneumatic tools are called for, 'Holman' tools are always specified. Good workmanship comes easily with Holman Pneumatic tools. Full details of the complete range of these tools will be gladly sent on request.

CHIPPERS. Models for all classes of chipping, caulking, etc.

RIVETERS. For all riveting jobs. Main and auxiliary valve as in chippers.

ROTODRILLS. For every type of job: hand-held and close-quarter drills, screw-feed types and wood-borers, reversible and non-reversible.

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RAMMERS. Floor and bench types. Piston stroke adjusts itself automatically to height of material. Usual butts and peins supplied.

PAINT SCRAPER. High-speed streamlined tool. Sensitive lever control. Chrome-plated cylinder. Various scrapes, chisels and small rivet snaps supplied.

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